CLAIMS

What is claimed is:

1. Apparatus for analyzing thin surface layers comprising:

A source of laser radiation;

Means for modulating the laser radiation at a single frequency, capable of operating over a broad bandwidth from the MHz-GHz frequency range;

An optical system for directing the modulated radiation to at least a first point on a surface of a thin surface layer to cause an acoustic wave therein;

Means for sensing a response of the thin surface layer to the acoustic wave;

Means for limiting the sensor bandwidth to a narrow frequency range; and

Means for analyzing the sensed response to provide an indication of properties of the thin surface layer.

2. The apparatus of any previous claim wherein said laser source is operating at or around 1.5 micron

3. The apparatus of any previous claim wherein said laser source is operating at or around 1.3 microns.

4. The apparatus of any previous claim wherein said laser source is operating at or around 1.064 microns.

5. The apparatus of any previous claim wherein said laser source includes an electro-absorption modulator to modulate the amplitude of the laser.

6. The apparatus of any previous claim wherein said laser source includes a Mach Zehnder modulator to modulate the amplitude of the incident laser radiation.

7. The apparatus of any previous claim wherein said laser source includes an electro-optic modulator to modulate the amplitude of the incident laser radiation.

8. The apparatus of any previous claim wherein said laser radiation source includes an erbium fiber amplifier to amplify the laser radiation.

9. The apparatus of any previous claim wherein said optical system includes lens for focusing the laser radiation to a spot on said thin surface layer.

10. The apparatus of claim 8 or 9 further including means for adjusting the position for said laser radiation relative to said thin surface layer.

11. The apparatus of any previous claim wherein said sensing means further includes:

a second source of detection laser radiation;

a second optical system for applying said detection radiation to said thin surface layer at a second point and receiving return radiation therefrom; and means for analyzing the returned radiation for information on the condition of said thin surface layer.

12. The apparatus of claim 11 wherein said second optical system includes an optical interferometer for detecting the displacement or velocity of the sample surface.

13. The apparatus of claim 11 or 12 wherein said sensing means includes means for detecting over a frequency range at a fixed distance between the first and second points and means for Fourier transforming to convert the signals from a frequency domain into a time domain for analysis.

14. The apparatus of any previous claim further including a RF lock-in amplifier or a network analyzer providing narrow bandwidth detection of the acoustic waves.

15. The apparatus of claim 13 including means for moving said first point in evenly spaced steps, and means for detecting real and imaginary components at each step using a Fourier transform to determine spatial frequencies of acoustic modes and acoustic wave velocities by dividing a detected temporal frequency by spatial frequencies of the acoustic modes.

16. The apparatus of any previous claim wherein said thin surface layer is selected from the group consisting of thin films, coatings, MEMS devices, NEMs devices, liquid based bio-samples.

17. A method of analyzing properties of thin surface layers using the apparatus of any previous claim.